

5 Claims

1. A process for the pyrolysis of biomass and other carbonaceous materials releasing a pyrolytic gas high in volatile organic compounds and producing a solid carbon charcoal residue.
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2. The process as in Claim 1 where the temperature of the charcoal is managed to such that its does not exceed the temperature range between 350C where 500C for more than 2 minutes to maximize the formation of surface acids groups and preferential adsorption of bases which include ammonia.
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3. The process as in Claim 1 where the temperature of the resulting char particles exceeds 500C and is further heated or allowed to oxidized where the temperature remains above 600C for greater than 10 minutes to minimize the production of surface acids groups.
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4. The process as in Claims 1, 2 and 3 wherein the residue is further processed under various conditions, including but not limited to pressure, mechanical actions, heat, steam, oxygen, acid, carbon dioxide, addition of fertilizer components, such as potassium, magnesium, ammonium sulfate, ammonium nitrate, micro mineral nutrients such as iron molybdenum minerals, to optimize it for specific applications as an adsorbent and carrier of other materials.
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5. The process as in Claim 1, where in the gas is further processed using ceramic membranes to the convert and extract a purified hydrogen stream, or by using steam reforming or catalytically reforming of the pyrolysis or synthesis gas to produce a mixture gases including hydrogen, carbon monoxide, methane and carbon dioxide and where the carbon monoxide is produced it is converted through a high temperature or low temperature
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- 5 catalytic CO water shift reaction to hydrogen where hydrogen and carbon
dioxide are the major components of the resulting gas.
6. The process as in Claim 5, for separating the any unpurified hydrogen
from carbon dioxide, nitrogen or other parasitic gases using standard
10 industrial techniques, such as pressure swing adsorption, or membrane
separation.
7. A process in accordance with Claims 1, 5 and 6, where the combination of
the hydrogen and air are used in standard industrially accepted techniques
15 to produce ammonia or ammonium nitrate or other nitrogen compounds
typical to those industry practices.
8. The process in accordance with Claims 2 and 4, whereby all or a portion of
the solid charcoal and ammonia, and water is injected or brought into
20 intimate contact with the off-gas stream of a combustion or other process
where such gas stream has a concentration of carbon dioxide, sulfur
dioxide and nitrous oxide and where there is a desire to reduce the
discharge of these materials into the atmosphere.
9. The process in accordance with Claims 3 and 4, whereby all or a portion of
the solid charcoal, and ammonia, and water is injected or brought into
intimate contact with the off-gas stream of a combustion or other process
where such gas stream has a concentration of carbon dioxide, sulfur
25 dioxide and nitrous oxide and where there is a desire to reduce the
discharge of these materials into the atmosphere.
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10. The process in accordance with Claims 8 and 9, where the charcoal residue
and ammonia, water and off gases are held in intimate contact for at least 5
seconds.

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- 5 11. The process as in Claim 10 wherein the chemical reaction will allow
 ammonium bicarbonate (NH_4HCO_3) to be formed in the charcoal pores
 and onto its surface to produce NH_4HCO_3 - charcoal fertilizers.
- 10 12. The process as in Claim 10 wherein the chemical reaction also allows the
 formation of ammonium salts of nitrogen oxides and sulfur dioxide to be
 formed in contact with NH_4HCO_3 -charcoal fertilizers.
- 15 13. The creation of a slow release sequestering soil amendment fertilizer to be
 combined with materials used by plant growth and depositing those
 materials inside the internal pore structures of the carbon residue making a
 solid powder and or granular material suitable for large scale agricultural
 applications.
- 20 14. A process in accordance with Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, or
 13 where those compounds beneficial for plant growth are created or
 adsorbed onto the internal pore structure of the carbon residue creating a
 material which provides a slow release of the compounds.
- 25 15. A process in accordance with Claim 13, and a coating is used to facilitate
 the handling, flow and added control of the rate of release of those
 compounds, and where such materials as are commonly used to create
 coatings such as but not limited to gypsum, plaster, sulfur, polymers as
 materials which dissolve or create a permeable layer when placed in the
 soil.
- 30 16. The use of a material as a soil amendment and fertilizer made with the
 processes described in Claims 1 through 11 and creating those materials as
 described in Claims 11, 12 or 13.